

**THE**



**LITTLE**

**GREEN BOOK**



**OF**

**CONCRETE**



**PRECAST CONCRETE FOR  
SUSTAINABLE CONSTRUCTION**

# ACKNOWLEDGEMENTS

This is the second publication in the “Little Book” series published by the National Precast Concrete Association in conjunction with the British Precast Concrete Federation Ltd., which developed the original concept for the Little Green Book of Concrete and our original publication, The Little Book of Concrete. NPCA gratefully acknowledges British Precast for its assistance with this publication.



[www.precast.org](http://www.precast.org)



[www.britishprecast.org](http://www.britishprecast.org)

Copyright 2008

Material in this publication may not be reproduced without written permission from NPCA. Requests for permission should be directed to:

NPCA Little Green Book of Concrete

10333 N. Meridian St., Suite 272

Indianapolis, IN 46290

(800) 571-0041

NPCA is a trade association representing manufacturers of precast concrete and suppliers to the industry.

NPCA is a member of the United States Green Building Council.



# TABLE OF CONTENTS

Acknowledgements	2
Definitions	4
Introduction	5
For the Future	6
Efficient Use of Natural Resources	7
Uses Plentiful, Local Natural Resources	9
Promotes Conservation and Recycling	21
Lean Thinking Means Less Waste	33
Built to Last, Saving Valuable Resources	49
Conserves Energy	61
Versatile Products for Sustainable Construction	71
Protecting the Environment	89
Notes and Resources	97
Looking to the Future	110

## DEFINITIONS

In *The Little Green Book of Concrete*, the term “precast concrete” includes all high-quality plant manufactured products for commercial and residential construction. These include water, wastewater, sanitary and stormwater systems, transportation infrastructure products, landscaping and architectural elements, and custom-made items. Specific products include reinforced concrete pipe, load-bearing precast elements, foundation walls, sound-barrier walls, retaining walls, floor and roof slabs, architectural panels, paving elements, modular housing, manholes, box culverts, utility boxes, grease and oil interceptors, septic tanks, treatment plants, precast tanks, bridges, piers and tunnels.

This proven, strong, versatile and durable material serves a multitude of society’s needs every day. Using local labor and recyclable materials, precast concrete provides sustainable construction and long service life for:

- Shelter and protection against the forces of nature
- Drinking water, drainage and sanitation systems
- Transportation and communications infrastructures
- Energy supply systems
- Commercial, residential, educational and health care facilities

## INTRODUCTION

Demand is increasing for construction options that will contribute to achieving sustainable development. In this little book, the architect, the designer, the engineer, the client, the specifier, the insurer and the environmentalist will all find examples of the sustainable attributes of precast concrete. The precast industry is working hard to increase resource efficiencies, material recycling and environmental awareness by adopting new, green technologies and initiatives to build sustainably.

We hope you enjoy reading how sustainable construction can be achieved with precast concrete products and systems. For additional information, please see the Notes and Resources section starting on page 100.



## FOR THE FUTURE

Look around. Much of the constructed world we live in is made of concrete. Concrete is universal, it is ubiquitous; you can find it everywhere for a reason. Like man-made stone, concrete is strong, durable and eminently serviceable. It is the most common building material in the world. But did you know that precast concrete is used for green, environmentally friendly, sustainable construction? That precast concrete uses natural and recyclable materials? That precast concrete products themselves can be reused and that precast concrete can build the most efficient structures for wind power? Learn how precast concrete is building a better world and a healthier, sustainable environment for future generations.

*Sustainability is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

## **EFFICIENT USE OF NATURAL RESOURCES**

As stewards of the earth for future generations, we have a responsibility to use our natural resources wisely by carefully specifying building products that will ensure that materials have a high recycled content, wherever appropriate. Materials that are used to make precast concrete are available locally and are plentiful throughout North America, but we cannot take this bounty for granted.

Steps are being taken by the industry to encourage resource efficiency and to minimize waste throughout the manufacturing and construction process. Specifiers can be confident that precast concrete products are sourced responsibly.

End-of-life-cycle destinies such as recycling of concrete, concrete aggregates or removal-relocation/reuse of building components in renovated or new construction are increasingly being considered.





**USES PLENTIFUL, NATURAL  
RAW MATERIALS**

## MINIMAL PROCESSING MEANS LESS ENERGY USAGE

All the materials that go into precast concrete come from natural and recycled sources, mainly inorganic. This means precast concrete components are subject to minimal processing or chemical treatment to render them suitable for use. Minimal component processing results in concrete with relatively low embodied-energy value, unlike highly processed materials such as plastics.



Use of local raw materials and labor supports regional economies and employment. More than \$27 billion in sales are generated by nearly 4,000 U.S. and Canadian precast companies with a combined 140,000 employees.

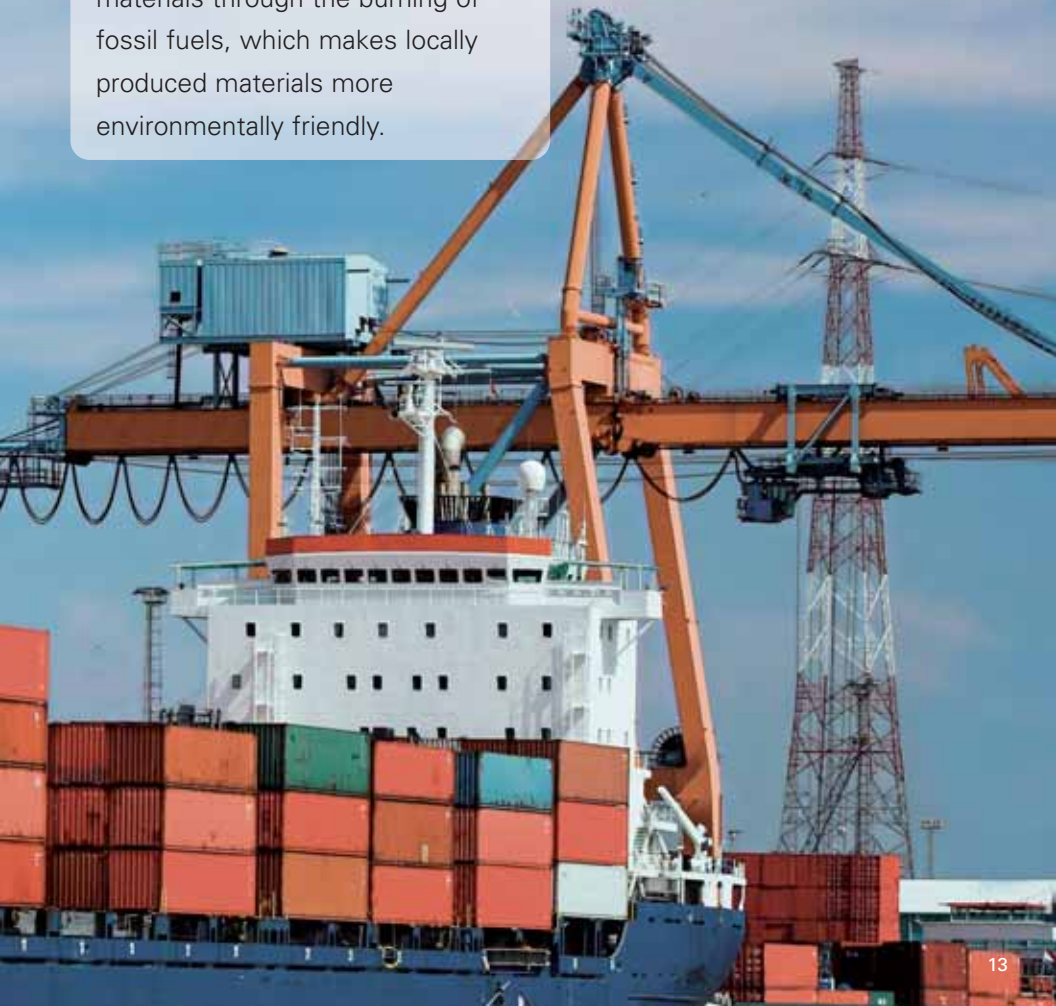




## **NO NEED TO IMPORT – PRECAST IS LOCAL**

Most materials for precast products can be obtained locally, so with precast there's simply no need to import materials from thousands of miles away.

Transportation costs can double the carbon footprint of construction materials through the burning of fossil fuels, which makes locally produced materials more environmentally friendly.







## **INCORPORATES ABUNDANT NATURAL RESOURCES**

Precast concrete products consist predominantly of natural aggregates – sand, coarse and fine stones from rock quarries or river gravels. The sand and stone basic to concrete manufacturing are in abundance throughout North America.

## **USES CEMENTITIOUS MATERIALS FROM A RESPONSIBLE INDUSTRY ...**

The U.S. cement industry works closely with the Environmental Protection Agency in continuing to develop new technology and standards to improve air quality and reduce emissions of particulates from cement production. The portland cement industry took responsibility for addressing climate change in the 1970s and continues to improve its manufacturing processes to reduce harmful emissions. In the last 30 years, the cement industry has reduced CO<sub>2</sub> emissions by more than 30 percent.





## **... WHICH IS REDUCING ITS CARBON EMISSIONS**

Many people don't realize that cement and concrete are two different materials. Cement powder is only one constituent of wet or hardened concrete. It is true that making cement powder in a kiln requires a great deal of heat energy, but the amount of non-renewable fossil fuels used to produce this heat is being reduced. In fact, U.S. cement production consumes less energy than the steel and wood industries.



## LOCAL PRODUCTION FACILITIES ...

Most precast concrete products are manufactured locally. Using criteria from the U.S. Green Building Council, precast concrete products can help accrue LEED (Leadership in Energy and Environmental Design) points for component materials obtained locally.





## **... MEANS USING LESS CARBON**

The local supply network for precast means travel distances are shorter and so the fuel used during transport is minimized. With the unprecedented high costs for fuel worldwide, savings in transportation costs bodes well for both the bottom line and the environment. Precast concrete is a viable, sensible and environmentally-friendly option for reducing a project's carbon footprint.



**PROMOTES CONSERVATION  
AND RECYCLING**

## **CONSERVES WATER RESOURCES IN THE PLANT ...**

Many precast plants now incorporate concrete wastewater and cement recycling systems. Sustainable plant upgrades using emission control equipment recycle concrete dust and concrete washout water used in precast product manufacturing.



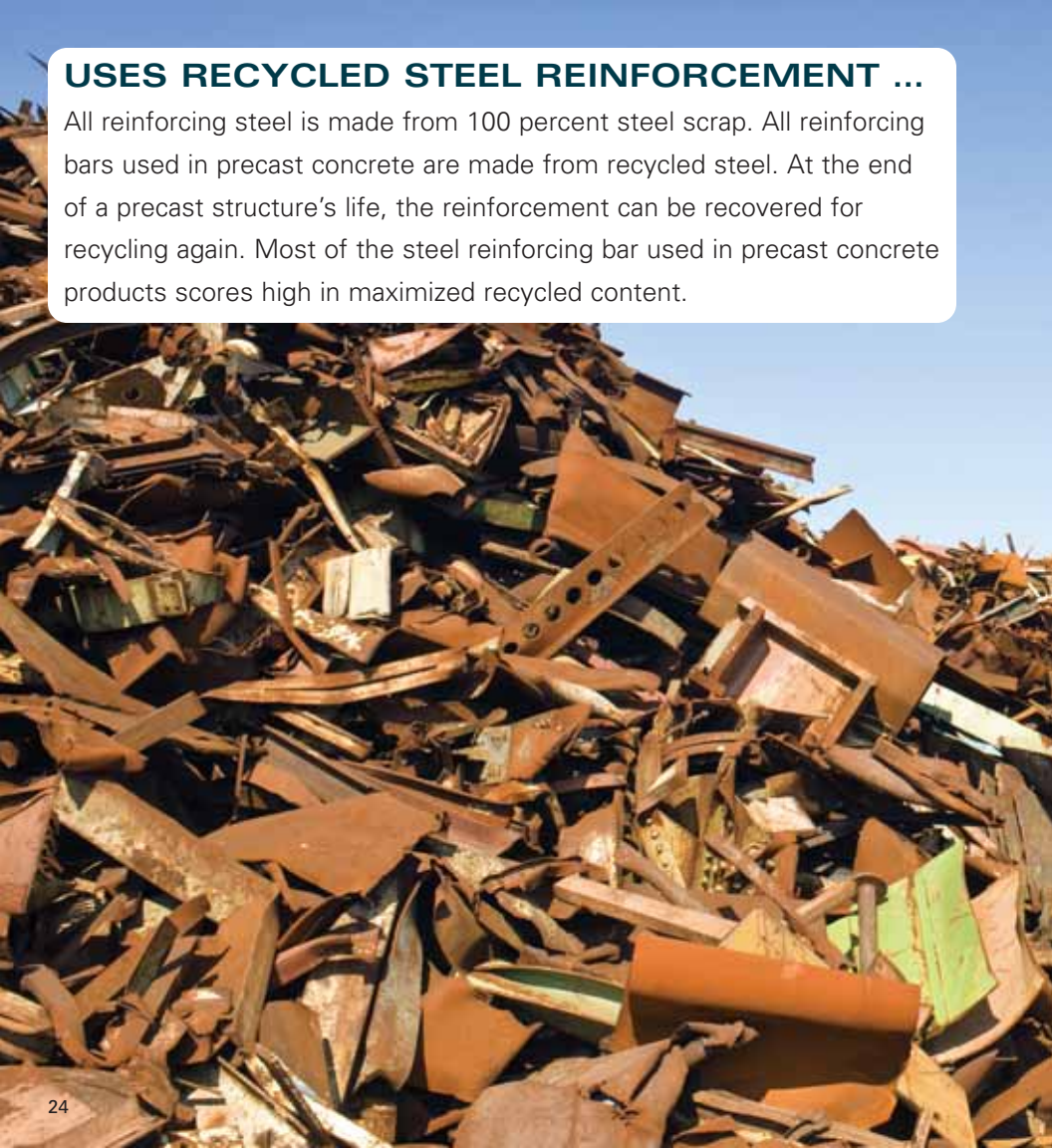


## ... AND ON SITE

Unlike other construction materials, precast concrete erection is much less disruptive to the site environment, producing far less construction debris, dust, noise and pollution. Precast concrete minimizes adverse impacts not only to the natural environment but to workers and the local community.

## **USES RECYCLED STEEL REINFORCEMENT ...**

All reinforcing steel is made from 100 percent steel scrap. All reinforcing bars used in precast concrete are made from recycled steel. At the end of a precast structure's life, the reinforcement can be recovered for recycling again. Most of the steel reinforcing bar used in precast concrete products scores high in maximized recycled content.





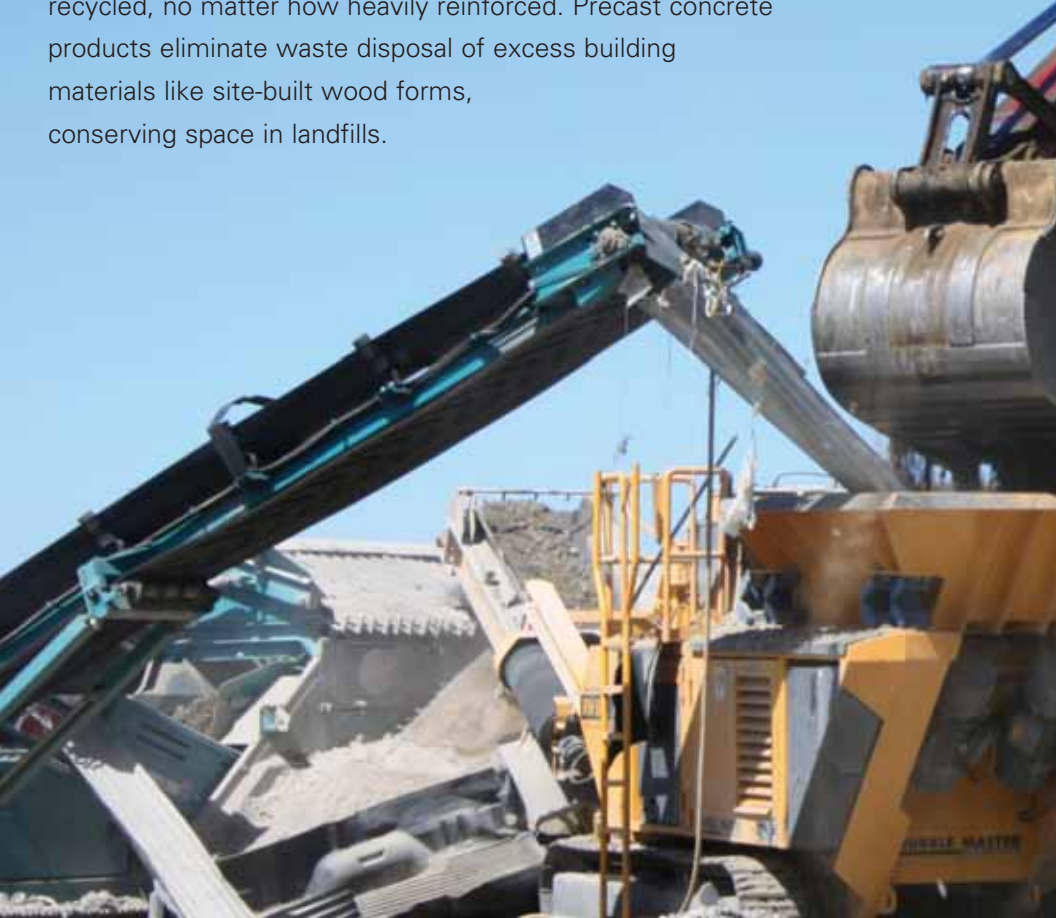


## **... AND BYPRODUCTS FROM OTHER INDUSTRIES**

Precast concrete mix designs often include industrial byproduct materials such as ground blast furnace slag (GGBS) from the steel industry and fly ash from power plants generated by fossil fuels. These byproducts would otherwise be relegated to a landfill. Using supplementary cementitious materials like fly ash and slag can significantly decrease precast concrete's carbon footprint.

## **RECYCLING AVOIDS EXPENSIVE LANDFILL COSTS**

As with many concrete products, precast is easy to crush and recycle for use as aggregate – almost 100 percent of a concrete building can be recycled, no matter how heavily reinforced. Precast concrete products eliminate waste disposal of excess building materials like site-built wood forms, conserving space in landfills.





## **THINK SMALL ...**

Even small amounts of unused cement powder or waste concrete slurry water in the precast fabrication can be recycled to conserve resources and to reduce material and energy costs for manufacturers. Unused concrete can also be crushed and recycled. Process water in precast plants can be filtered and recycled back into production.



## ... THEN THINK BIG!

As more and more precasters adopt sustainable technologies, it is possible that virtually all wet waste can be routed to a central recycling plant onsite where aggregates can be cleaned and returned to stockpiles or crushed with dry concrete waste and reused. Recapture and recycling systems for precast concrete production byproducts have the potential to virtually eliminate all waste, which is great news for the environment.



## A VISIONARY WORKFORCE ...

Some of the best ideas and initiatives for enhanced safety, energy and waste savings come from the production floor. In one southeastern precast plant, managers realized a 95 percent reduction in water usage through installation of washwater recycling equipment.





## **... WITH CLOSE LINKS TO THE COMMUNITY**

Adoption of informed recycling and waste minimization practices at precast facilities is appreciated by the local community. Reduction of operating noise, cement dust and waste generation helps to make precast plants good neighbors.





**LEAN THINKING MEANS  
LESS WASTE**



## **IT'S ALL ABOUT IMPROVING RESOURCE EFFICIENCY**

Sustainability in the precast concrete facility is all about improving resource efficiency, reducing waste and trimming operational costs. Retrofits to existing precast facilities and incorporation of major recycling systems to new factories are helping to improve the industry's sustainability profile.

## **A CONTROLLED PLANT ENVIRONMENT ...**

Precast concrete is manufactured in plants under strictly controlled conditions, which means excellent resource efficiency for materials, labor, energy and processes. Most precast concrete facilities are clean and productive, with computer-controlled processes for batching, mixing and casting. Major efficiency programs are also helping reduce plant energy consumption.





## **... MAKES SUSTAINABILITY EASIER TO ACHIEVE**

Working closely with the precast manufacturers at the beginning of a project's design can enable engineers and architects to find ways to achieve LEED points both above ground and underground.

## **PLANT PRODUCTION MEANS A QUALITY PRODUCT ...**

Unlike the weather, precast plants are predictable, with regular production schedules and skilled workforces. This production standardization produces high-quality precast that can be delivered to a site just-in-time. There's no waiting around for concrete to cure on-site and no need to stockpile.





## **... THAT IS GETTING BETTER ALL THE TIME**

Innovations like the use of self consolidating concrete (SCC) are revolutionizing precast concrete production, as vibration is no longer needed to ensure compaction of wet concrete in the forms. In addition to reducing vibration, energy use and increasing form life with SCC, the precaster obtains a higher quality product that requires no finishing.







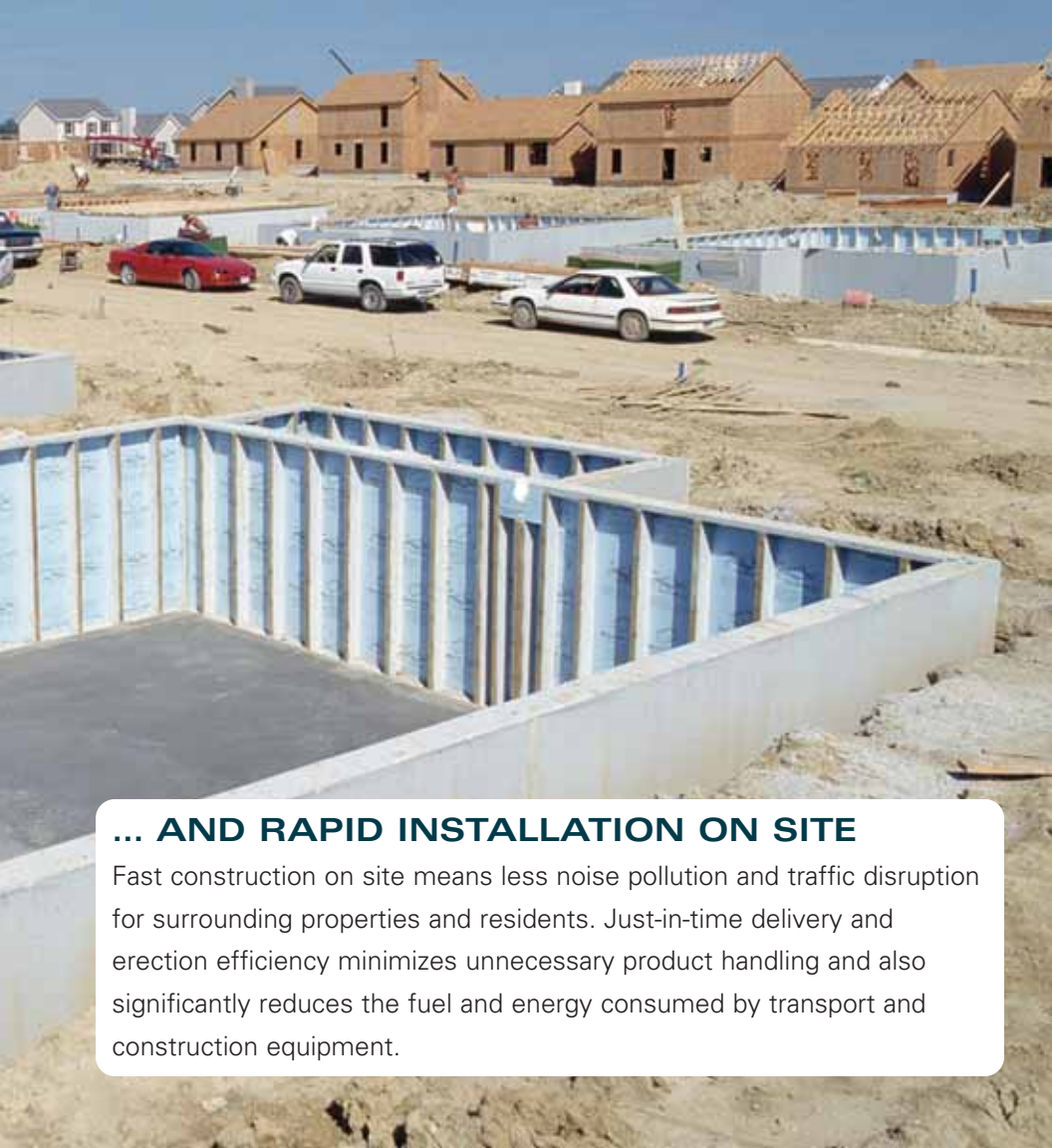
## **CONSISTENT RESULTS, OVER AND OVER AGAIN**

High-quality reproduction of individual precast units can be achieved with confidence in a precast facility, whether one, 10 or 1,000 identical components are required for a project. Multiple reuse of precast forms saves materials, resources, energy and time, and prevents forms from premature disposal.

## **CLEANER CONSTRUCTION SITES ...**

The production of precast concrete in an off-site manufacturing plant means that construction sites are cleaner, quieter and safer. Precast construction generates much less construction site debris and potential pollution to streams and natural areas.





## **... AND RAPID INSTALLATION ON SITE**

Fast construction on site means less noise pollution and traffic disruption for surrounding properties and residents. Just-in-time delivery and erection efficiency minimizes unnecessary product handling and also significantly reduces the fuel and energy consumed by transport and construction equipment.

# CONSTRUCTION WASTE IS NOT GENERATED ...

With thousands of tons of waste generated in construction every year, the use of prefabricated precast concrete is clearly a great advantage. Precast concrete systems greatly reduce unnecessary building materials from ever reaching a project site.





## **... IT OFTEN NEVER EVEN APPEARS**

Because precast concrete arrives on site already reinforced and with its surfaces finished according to specification, it does not require lengthy assembly or finishing as with other building materials. Production and finishing materials and the waste they produce never even reach the project site.

## **REDUCES NOISE LEVELS ON THE BUILDING SITE ...**

Vibration, sawing and other noise-pollution activities that are part of concrete pours on the job site are eliminated because the precast is produced offsite. This results in substantially quieter construction sites.





## ... AND FOR NEIGHBORING PROPERTIES

The easy installation of precast products makes for less noise pollution from the construction site, a significant benefit to those inhabiting or working in adjoining properties. In addition, construction of a precast concrete structure generates very little dust – decreasing the likelihood of problems with dirt and poor air quality, the most common causes for complaints from residents near construction sites.





**BUILT TO LAST, SAVING  
VALUABLE RESOURCES**



Manitowoc

777

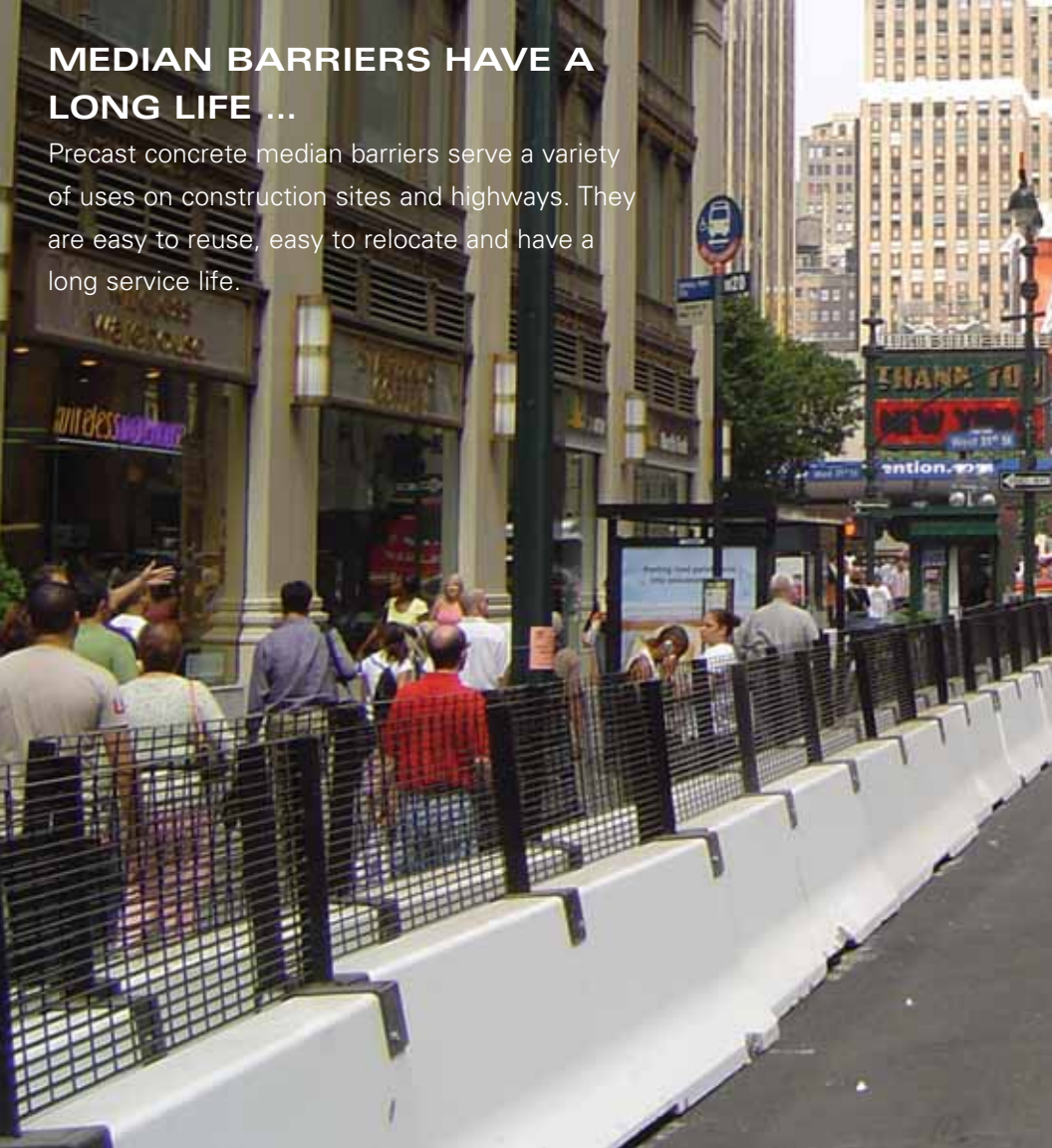


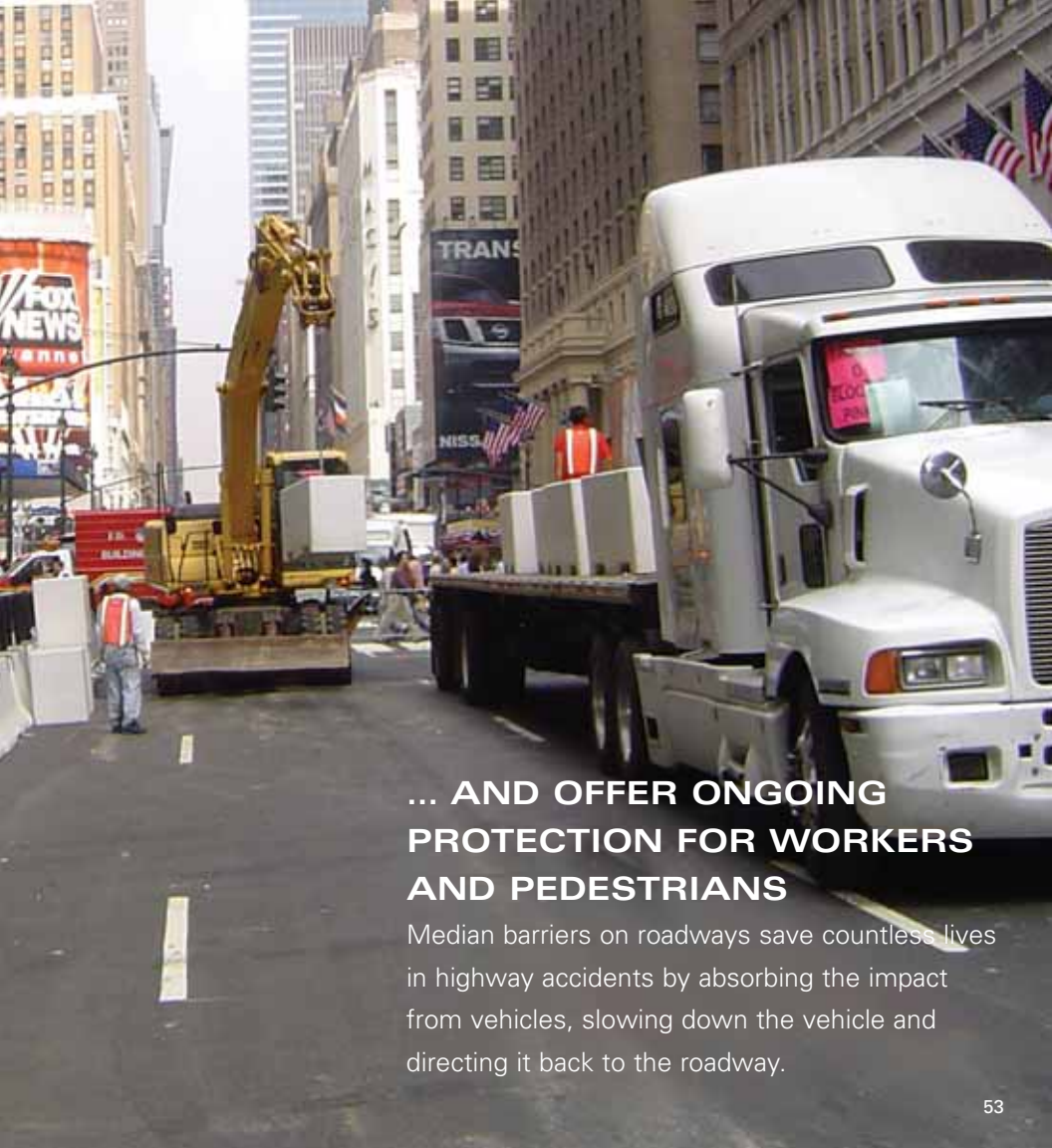
## **CAN BE REUSED AND RELOCATED**

Precast concrete units can be disassembled in an existing structure and moved or reconfigured for building remodeling, expansion or for use in new construction. No other building system can boast of this kind of recycling efficiency.

## MEDIAN BARRIERS HAVE A LONG LIFE ...

Precast concrete median barriers serve a variety of uses on construction sites and highways. They are easy to reuse, easy to relocate and have a long service life.





## **... AND OFFER ONGOING PROTECTION FOR WORKERS AND PEDESTRIANS**

Median barriers on roadways save countless lives in highway accidents by absorbing the impact from vehicles, slowing down the vehicle and directing it back to the roadway.

## WEATHERPROOF

Precast concrete is highly resistant to rain penetration and wind-blown debris – offering the best protection of any construction material from storms and bad weather. Precast will not catch fire or burn.





## **RESISTANT TO THE EFFECTS OF CLIMATE CHANGE**

Global warming theories include credible predictions for higher winds, more driving rain, stronger monsoon seasons, flash floods, mud slides and more frequent and stronger hurricanes in the future. Precast concrete products offer better protection against these potential future effects of climate change, because precast concrete is inherently durable and offers proven structural integrity.

## **DURABLE FROM DAY 1 ...**

Concrete buildings and structures built hundreds of years ago are still in use today. Some concrete pipe is still serving its original function when it was installed underground a century ago. When you're talking sustainability, we wrote the book!







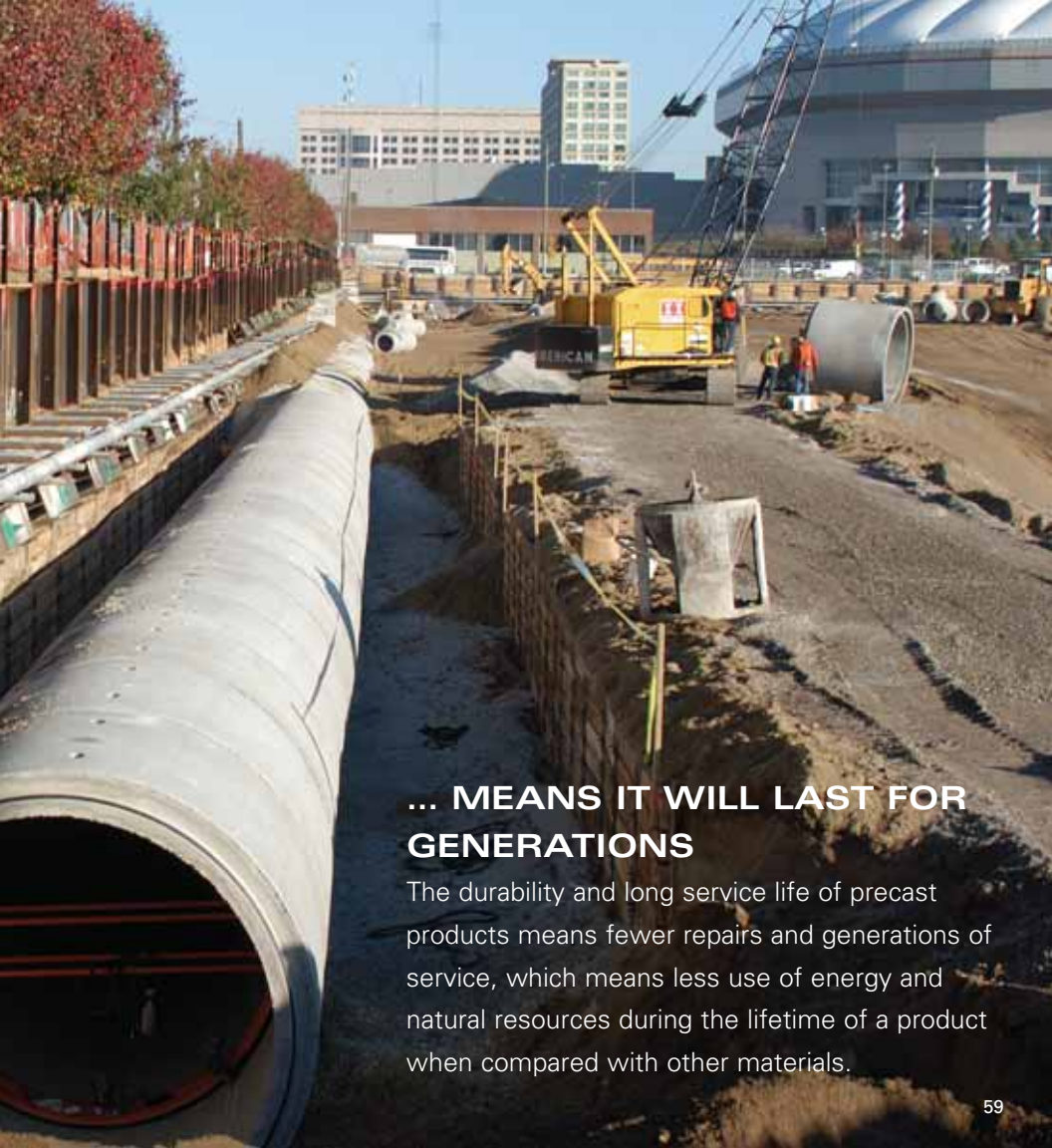
## **... AND IT GETS STRONGER EVERY DAY**

It is a scientific fact that precast concrete continues to increase in compressive strength for many years after it is cast. What's more, during that time it won't shrink, warp or move (creep) excessively, so it can be relied upon to perform consistently year after year.

## EVERYDAY RESILIENCE ...

Precast concrete is not only tough and durable – it handles high-pressure loading with ease. For example, used for underground pipes, precast concrete is resistant to high-pressure water jetting used in system maintenance.





## **... MEANS IT WILL LAST FOR GENERATIONS**

The durability and long service life of precast products means fewer repairs and generations of service, which means less use of energy and natural resources during the lifetime of a product when compared with other materials.



**CONSERVES ENERGY**

## **MINIMIZES EMBODIED AND OPERATIONAL ENERGY ...**

The energy associated with construction (embodied energy) typically accounts for just 10 percent of a building's energy use (or carbon footprint) over its lifetime, so emphasis is more often placed on the in-service (operational) energy consumed. It is also important, however, to reduce embodied energy whenever possible. Both construction and in-service energy reductions are possible with precast concrete systems.



Photo courtesy of  
Nitterhouse Concrete Products Inc.



## **... WHICH CAN SAVE TONS OF CARBON OVER A BUILDING'S LIFESPAN**

Studies on innovative precast floor slabs have shown a 35 percent to 50 percent weight savings. For an average-sized building, this can result in an embodied energy saving of about 184 tons of carbon, the equivalent of 60 car-years of carbon dioxide emissions, primarily from the reduction in cement used. Precast concrete structures can potentially contribute up to 23 points for LEED certification of new buildings per USGBC guidelines.

## HAS LONG-TERM BENEFITS ...

Over 60 years, a concrete home emits up to 15 tons less carbon dioxide than a lightweight alternative, thereby providing an environmentally better long-term solution.

Research shows that, over a 30-year period, concrete structures are more cost-efficient than steel, because they require less energy to heat and cool.







## **... THAT MAKE GOOD CARBON SENSE**

During its lifetime, precast concrete will effectively reabsorb much of the carbon dioxide that was used to create it in the first place. Precast units, aggregate blocks and air-entrained concrete will naturally reabsorb the carbon dioxide used (or released to the atmosphere) in creating them by curing over time in a process called carbonation.

## DECREASES RELIANCE ON FOSSIL FUELS ...

Precast concrete technology has unfurled its sails to wind power in the unprecedented growth of wind farm expansions worldwide. Only precast concrete designs can economically help wind turbines reach the altitude necessary for maximum turbine efficiencies and high wind speeds.



Photo courtesy of  
Advanced Tower Systems and  
WEC Turnbau GmbH.



## **... AS THE MATERIAL OF CHOICE FOR AN EMERGING TECHNOLOGY**

The great advantage of precast construction for wind turbines is the perfect win-win scenario: use of a green product to generate renewable energy!

## **HELPS REDUCE THE “URBAN HEAT ISLAND”**

During hot weather, light-colored concrete finishes, including pavement and roofing tiles, reflect more sunlight and heat than dark surfaces, enabling buildings to stay cooler and reducing the “urban heat island” effect. This reduces urban energy use, because people use less air conditioning, potentially saving millions of dollars in energy costs every year.







**VERSATILE PRODUCTS FOR  
SUSTAINABLE  
CONSTRUCTION**

## **LEEDING THE WAY ...**

The green building revolution has transformed the construction industry, with LEED (Leadership in Energy and Environmental Design) properties playing a significant role in design and retrofitting of buildings. Designing with precast concrete can gain LEED points both above-ground and underground.





## ... TO A MORE SUSTAINABLE FUTURE

As more and more engineers are designing and specifying green buildings, they need confidence in the products they select. NPCA certified plants provide a proven level of quality assurance for today's demanding construction projects.

**NPCA**  
CERTIFIED PLANT





## **TAILORED TO REQUIREMENTS ...**

Precast concrete can be dense or lightweight, allowing for options when designing a structure's thermal or insulating behavior. Dense precast concrete can serve as a thermal sink and sound barrier, while lightweight concrete can be an effective insulator; in some buildings, it performs both functions.



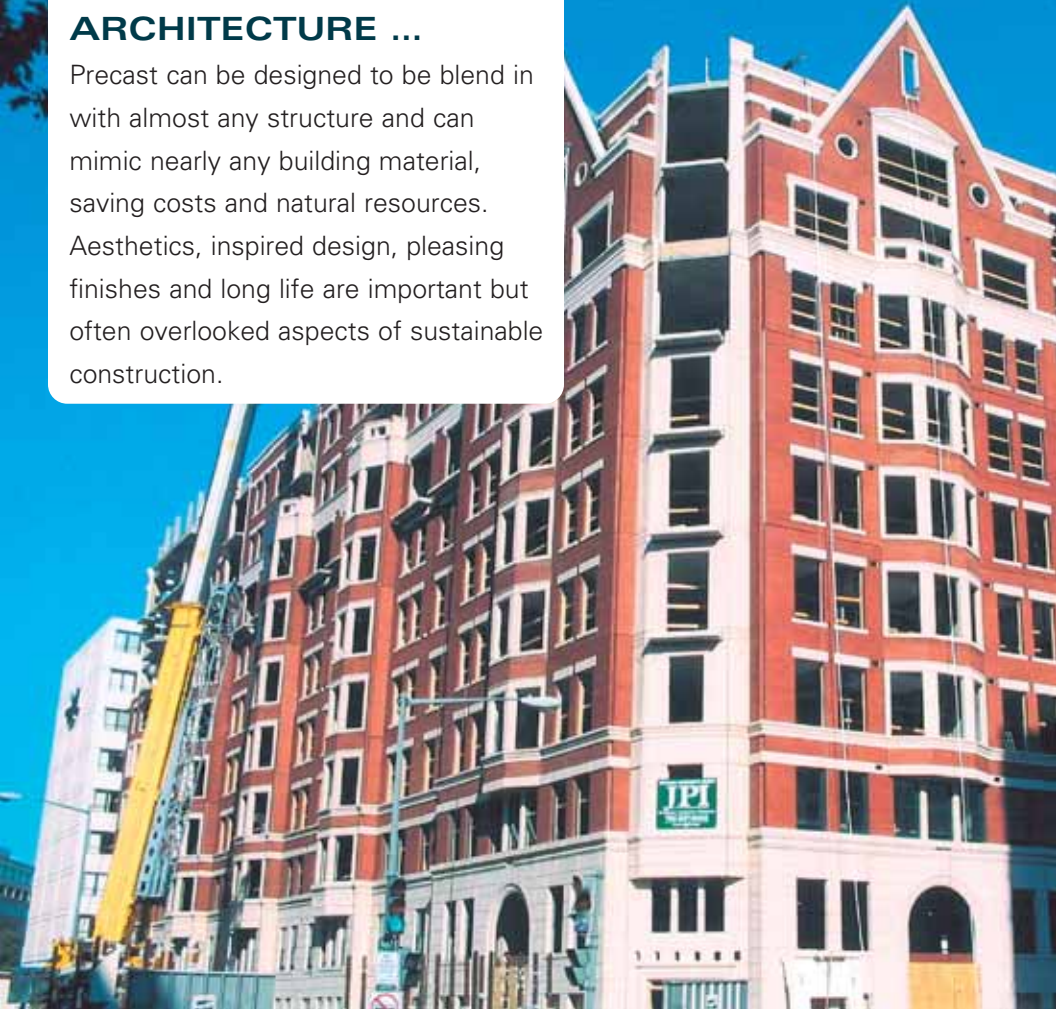


## **... AND THERMALLY VERSATILE**

From foundations to flooring systems to roofing tiles, precast concrete components can be deployed to take advantage of concrete's versatile thermal properties, providing serious savings on heating and cooling costs.

## **BLENDS IN WITH EXISTING ARCHITECTURE ...**

Precast can be designed to be blend in with almost any structure and can mimic nearly any building material, saving costs and natural resources. Aesthetics, inspired design, pleasing finishes and long life are important but often overlooked aspects of sustainable construction.





## **... THAT IS LIMITED ONLY BY THE IMAGINATION**

The range of finish textures and colors possible with precast concrete is practically limitless – from exposed aggregate, colored textures and historical restorations to elegant bridges and floating piers for marine craft. Precast concrete can be fabricated to replicate natural stone and can be produced in a multitude of architectural finishes, colors and styles.

## ESSENTIAL FOR SUSTAINABLE TRANSPORTATION SYSTEMS

Clean, greener options for commuting to work, school or home are integral components of any enduring plans for sustainability into the future. Precast concrete is used extensively to construct light rail systems for public transportation.

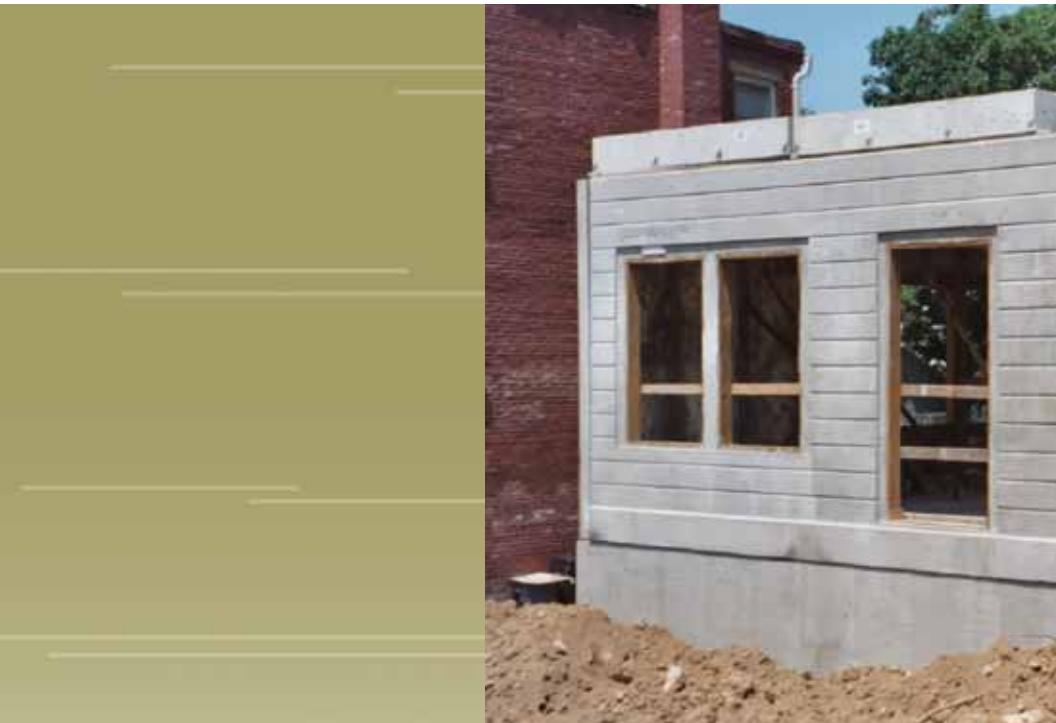








**IMPROVES QUALITY OF LIFE**



## **CREATES COMFORT INDOORS ...**

The thermal mass properties of concrete help even out daily and seasonal temperature swings, making indoor spaces more comfortable for occupants without having to resort to costly air conditioning.



## **...WHILE IT SAVES MONEY AND HELPS THE ENVIRONMENT**

With operational energy (heating and cooling systems) accounting for about 90 percent of the energy consumption of a building, the ability of precast concrete systems to moderate temperature extremes is both economically important and good for the environment.



## **HELPS CREATE HEALTHY INDOOR LIVING ...**

Precast housing reduces daily temperature ranges, meaning less internal condensation. A dryer interior means fewer dust mites, and less mildew and mold spores that may trigger asthma and other respiratory conditions.



### **... AVOIDING “SICK BUILDING SYNDROME”**

In its daily use, precast concrete is an inert substance, which means it does not emit or give off any gases, or toxic or volatile organic compounds. So you can breathe easy, because precast does not contribute to the symptoms of “sick building syndrome.”

## **CUTS DOWN ON NOISE POLLUTION**

As a dense material, precast concrete elements in a building make for a peaceful lifestyle by reducing noise pollution both outside and indoors. The mass of the concrete helps to deaden noise, whether from people talking, music and television broadcasts or children and pets.









# PROTECTING THE ENVIRONMENT

## KEEPS WATER IN ...

Precast is the perfect material for fluid containment, whether for water storage, domestic stormwater movement or transmission through pipelines. The strength and resilience of precast concrete is unmatched, making it the perfect product to move water and protect against contamination of groundwater.





## ... AND OUT!

Precast can be used to protect valuable underground electrical equipment, for flood protection in river and coastal barriers such as levees, breakwaters and dams.



## **REDUCES THE RISK OF FLOODING ...**

Permeable paving systems and porous concrete pavers are used in sustainable urban drainage systems. These systems help prevent rapid run-off of stormwater from roads and pavements in urban areas by allowing water to permeate quickly and naturally into the underlying soil.



## ... AND EASES THE CLEANUP

The high-quality surface of precast and the fact that it does not erode or rot makes the task of cleaning up after a flood a little easier. Because they are so sturdy, precast concrete structures help to minimize clean-up times and costs.

## **DOES NOT LEACH HARMFUL CHEMICALS**

Precast concrete will not leach or emit any harmful chemicals into the land, water or atmosphere over time. This inert quality is very important for the storage and transport of pure and safe drinking water, providing critical protection of our most precious natural resource – water.









# NOTES AND RESOURCES

*NPCA's Little Green Book of Concrete* is intended to inform and stimulate interest in the sustainable qualities of precast concrete products. For detailed information in this fast-moving area, we suggest that you visit some key Web sites on a regular basis:

[www.precastsolutions.org](http://www.precastsolutions.org)

[www.precast.org](http://www.precast.org)

[www.usgbc.org](http://www.usgbc.org)

[www.cement.org](http://www.cement.org)

[www.nssga.org](http://www.nssga.org)

[www.precast.org/publications/solutions](http://www.precast.org/publications/solutions)

[www.wbdg.org](http://www.wbdg.org)

[www.mapaprecast.org/leed.asp](http://www.mapaprecast.org/leed.asp)

[www.concretethinker.com](http://www.concretethinker.com)

[www.cement.org/buildings/precast](http://www.cement.org/buildings/precast)

## Page 12-13

See also:

[www.cement.org/tech/cct\\_aggregates\\_recycled.asp](http://www.cement.org/tech/cct_aggregates_recycled.asp)

[www.cement.org/smreport07/sec\\_page3\\_1.htm](http://www.cement.org/smreport07/sec_page3_1.htm)

[www.cement.org/buildings/sustainable\\_cement.asp](http://www.cement.org/buildings/sustainable_cement.asp)



## Page 14

The manufacture of concrete incorporates cement powder and naturally occurring, recyclable and abundant resources such as water, rock and sand. Most precast



concrete mixes are made up of materials that have a low carbon footprint, including sand, gravel or crushed rock in addition to its cement powder content. The confusion between the carbon footprints of cement production and hardened concrete is the major source of misinformation about the real beneficial sustainability characteristics of precast concrete.

See also:

[www.nssga.org/sustainability/case.html](http://www.nssga.org/sustainability/case.html)

[www.cement.org/buildings/sustainable\\_cement.asp](http://www.cement.org/buildings/sustainable_cement.asp)

## Page 16

In addition to an ongoing commitment to reducing carbon dioxide emissions, it is important to note that more than 75 percent of cement kiln dust (CKD) is captured and recycled into the cement manufacturing process. CKD also has beneficial uses in agricultural soil and waste stabilization.



## Page 22

Precast manufacturers understand the environmental and economic advantages of reclaiming aggregates and recycling wastewater. Less waste goes to landfills and byproduct disposal, and water use costs are substantially reduced.



## Page 24

For more information on recycled steel reinforcement in concrete, see:

[www.crsi.org/pdf/recycling\\_report.pdf](http://www.crsi.org/pdf/recycling_report.pdf)

[www.fhwa.dot.gov/pavement/recycling/recsteel.cfm](http://www.fhwa.dot.gov/pavement/recycling/recsteel.cfm)



## Page 25

Using supplementary cementitious materials like fly ash and slag can significantly decrease precast concrete's carbon footprint:

- Substituting 50 percent of cement with GGBS equals 40 percent less carbon dioxide
- Substituting 30 percent of cement with fly ash equals 20 percent less carbon dioxide

Ground granulated blast furnace slag (GGBS) and fly ash can also improve the performance of concrete. It is now possible to specify products with more than 70 percent of industrial byproduct materials. Supplementary cementitious materials, including pozzolans, microsilica, slag and fly ash, can replace significant amounts portland cement in concrete mixtures.

See also:

[www.precast.org/publications/mc/2004\\_sep/oct/cementitious\\_materials.htm](http://www.precast.org/publications/mc/2004_sep/oct/cementitious_materials.htm)

[www.nationalslag.org/](http://www.nationalslag.org/)

[www.nrmca.org/aboutconcrete/cips/30p.pdf](http://www.nrmca.org/aboutconcrete/cips/30p.pdf)

[cementamericas.com/mag/cement\\_breathing\\_easier\\_blast](http://cementamericas.com/mag/cement_breathing_easier_blast)

[circainfo.ca/factsheets.htm](http://circainfo.ca/factsheets.htm)

## Page 26

For more information on recycling of concrete, see:

[www.epa.gov/epaoswer/osw/recycle.htm](http://www.epa.gov/epaoswer/osw/recycle.htm)

## Page 28

See also:

[www.concretenetwork.com/concrete/demolition/recycling\\_concrete.htm](http://www.concretenetwork.com/concrete/demolition/recycling_concrete.htm)



## Page 29

As new precast concrete facilities in North America are built, manufacturers are considering closed-loop recycling systems using the latest technologies and equipment developed in Europe. As more plants are constructed and updated, precast concrete production in the future will set a new standard for manufacturing efficiency and will increase the industry's sustainability while realizing significant production savings.



## Page 38

For additional resources, see:

[www.precast.org/certification/qc\\_manual.htm](http://www.precast.org/certification/qc_manual.htm)

[www.precast.org/publications/mc/TechArticles/99\\_Fall\\_Automation.htm](http://www.precast.org/publications/mc/TechArticles/99_Fall_Automation.htm)

[www.precast.org/pages/20080204\\_safety.htm](http://www.precast.org/pages/20080204_safety.htm)



## Page 39

SCC makes the production environments quieter and safer and significantly reduces the power required for fabrication. SCC has been described as 'zero energy' in Europe.

See also:

[www.precast.org/publications/mc/2004\\_janfeb/scc.htm](http://www.precast.org/publications/mc/2004_janfeb/scc.htm)

[www.concreteproducts.com/mag/concrete\\_scc\\_makes\\_waves](http://www.concreteproducts.com/mag/concrete_scc_makes_waves)

## Page 40

See also:

[www.mapaprecast.org/leed.asp](http://www.mapaprecast.org/leed.asp)

[www.precast.org/publications/solutions/2007\\_fall/foundations.htm](http://www.precast.org/publications/solutions/2007_fall/foundations.htm)



## Page 45

Precast concrete can be cast with all required openings and recesses built in, so concrete cutting onsite is unnecessary.

Precast concrete takes advantage of significant up-front planning by owners, designers and engineers. All possible product efficiencies are considered to save the owner money and construct the project on schedule. Using precast translates into a cleaner construction site, efficient product delivery and erection, and minimal construction waste for landfill disposal.



## Page 54

In a study of exterior wall systems, Texas Tech University's Wind Engineering Research Center found that only concrete wall systems were proven to withstand 100 percent of all known hurricane-force winds and more than 99 percent of tornado-force winds.



Because precast concrete is fireproof, it protects against the spread of fire between rooms or properties. Fewer fire-related deaths are recorded proportionately in concrete buildings. In fire tests, concrete performs consistently well, typically needing very little remedial treatment following exposure to the high temperatures of a fire. In most cases, some minor patching

and a new coat of paint may be all that is required for repairs.

Studies in Sweden have indicated that a major fire is more than 10 times less likely to develop in houses built from concrete or masonry. Furthermore, Professor Ulrich Schneider of the Vienna University of Technology has found a clear link between construction materials and fire safety. There are about three times fewer fire victims in countries that build mainly in concrete, masonry and stone.

See also:

[www.precast.org/whyprecast/](http://www.precast.org/whyprecast/)

[www.cement.org/buildings/fire\\_SR352.asp](http://www.cement.org/buildings/fire_SR352.asp)

## Page 55

See also:

[www.ucsusa.org/global\\_warming/](http://www.ucsusa.org/global_warming/)

## Page 56

See also:

[www.sustainableprecast.ca/service\\_life/precast\\_sustainability/canada/index.do](http://www.sustainableprecast.ca/service_life/precast_sustainability/canada/index.do)



## Page 57

In northern climates, concrete can also withstand many winters of freeze-thaw cycles, unlike other materials that can deteriorate quickly with such regular seasonal exposure to temperature differentials. In damp, exposed or harsh marine conditions, other materials struggle to match the performance of concrete.

See also:

[www.wind.ttu.edu/Research/DebrisImpact/Reports/DIF\\_reports.pdf](http://www.wind.ttu.edu/Research/DebrisImpact/Reports/DIF_reports.pdf)

## Page 59

Precast concrete's inherent qualities can fulfill the sustainability goal of providing durable structures for future generations. In-plant fabrication ensures a quality product, while the design and material properties of precast ensure structural integrity and durability.

See also:

[www.cement.org/homes/ch\\_lc\\_us\\_illinois.asp](http://www.cement.org/homes/ch_lc_us_illinois.asp)

[www.precast.org/publications/solutions/2006\\_spring/building\\_confidence.htm](http://www.precast.org/publications/solutions/2006_spring/building_confidence.htm)

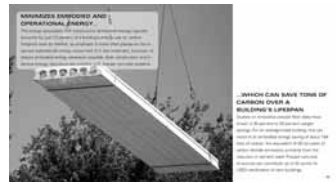


## Page 63

Significant weight reductions are possible through the use of void formers, which reduce the volume of cast-in-place concrete required on top.

See also:

[www.precast.org/publications/solutions/2008\\_may\\_june/sustainability.htm](http://www.precast.org/publications/solutions/2008_may_june/sustainability.htm)



## Page 65

See also:

[www.cement.org/tech/cct\\_dur\\_corrosion.asp](http://www.cement.org/tech/cct_dur_corrosion.asp)





## Page 66-67

Precast concrete is often used for wind turbine towers, especially in Europe. Its high level of weather resistance and inherent stiffness help provide a stable and resilient structure. Stacked precast concrete rings create wind turbine towers that generate green power from a renewable and abundant resource: the wind. However, the best locations to place wind turbines are also often in the harshest environments, as in offshore wind farms, so it is important to use a structural material with durability to resist corrosion.



With the unprecedented growth in wind power construction and U.S. government mandates for 20 percent alternative energy by 2020, precast concrete will be a major player in construction of green power systems.

See also:

[www.precast.org/publications/solutions/2008\\_july\\_august/wind.htm](http://www.precast.org/publications/solutions/2008_july_august/wind.htm)

[www.ats.eu](http://www.ats.eu)

## Page 72

For a truly credible sustainability profile of precast concrete as a green building system, many other factors must be taken into account, including the long service life of precast concrete; the ability to relocate and reuse of precast components; recycling potential; local availability; thermal mass properties; solar gain minimization (or reduction of urban heat island effect); higher occupant security and protection; resistance to insect attack; resistance to mold growth; impermeability; and excellent fire and wind force resistance.

See also:

[www.precast.org/publications/mc/2007\\_julyaug/LEED.htm](http://www.precast.org/publications/mc/2007_julyaug/LEED.htm)

[www.usgbc.org/](http://www.usgbc.org/)

[www.usgbc.org/DisplayPage.aspx?CategoryID=19](http://www.usgbc.org/DisplayPage.aspx?CategoryID=19)



## Page 74

[www.cement.org/bookstore/profile.asp?store=&id=225](http://www.cement.org/bookstore/profile.asp?store=&id=225)

[www.concretethinker.com/Papers.aspx?DocId=4](http://www.concretethinker.com/Papers.aspx?DocId=4)

[www.irishconcrete.ie/acoustics.html](http://www.irishconcrete.ie/acoustics.html)



## Page 75

See also:

[www.toolbase.org/Construction-Methods/Concrete-Construction/precast-concrete-passive-solar-homes](http://www.toolbase.org/Construction-Methods/Concrete-Construction/precast-concrete-passive-solar-homes)

[www.homeenergy.org/archive/hem.dis.anl.gov/eehem/97/970514.html](http://www.homeenergy.org/archive/hem.dis.anl.gov/eehem/97/970514.html)

## Page 76

See also:

[www.nps.gov/history/hps/tps/briefs/brief07.htm](http://www.nps.gov/history/hps/tps/briefs/brief07.htm)



## Page 78-79

See also:

[www.cement.org/transit/tr\\_cs\\_skytrain.asp](http://www.cement.org/transit/tr_cs_skytrain.asp)

[www.fhwa.dot.gov/bridge/segmental/ask.htm](http://www.fhwa.dot.gov/bridge/segmental/ask.htm)

[www.nowpublic.com/press/concrete-solutions-clean-air](http://www.nowpublic.com/press/concrete-solutions-clean-air)

[www.precast.org/publications/solutions/2006\\_fall/feature\\_words.htm](http://www.precast.org/publications/solutions/2006_fall/feature_words.htm)



## Page 82-83

Utilizing thermal mass in homes can save up to 20 percent in residential heating costs and can reduce energy needed for cooling by up to 50 percent. Taking advantage of precast concrete's thermal mass saves on capital investment and maintenance bills compared with traditional air-conditioned homes.



## Page 85

According to the U.S. Environmental Protection Agency, indicators of sick building syndrome include:

- Building occupants complain of symptoms associated with acute discomfort, such as headache; eye, nose, or throat irritation; dry cough; dry or itchy skin; dizziness and nausea; difficulty in concentrating; fatigue; and sensitivity to odors.
- The cause of the symptoms is not known.
- Most of the complainants report relief soon after leaving the building.

See also:

[www.epa.gov/iedweb00/pubs/sbs.html](http://www.epa.gov/iedweb00/pubs/sbs.html)



## Page 90-91

See also

<http://www.precast.org/manhole/index.htm>

<http://www.precast.org/pipe/index.htm>

<http://www.precast.org/septic/septic-tank.htm>

<http://www.precast.org/stormwater/index.htm>

<http://www.precast.org/vault/index.htm>

[www.acpa.org](http://www.acpa.org)

[www.precast.org/publications/solutions/2008\\_mar\\_apr/rcp.htm](http://www.precast.org/publications/solutions/2008_mar_apr/rcp.htm)

## Page 92

All precast paving allows some permeability; in contrast to hard surfaces with no joints that can pose problems. When rainfall cannot drain quickly to ground or to streams, water builds up and causes localized flooding, which is inconvenient, damaging and potentially dangerous.

See also:

[www.concretenetwork.com/concrete/porous\\_concrete\\_pavers/](http://www.concretenetwork.com/concrete/porous_concrete_pavers/)

## Page 94-95

Precast is proven safe to use in systems that distribute drinking water through tunnels. Precast concrete is used in treatment troughs in wastewater treatment plants where potentially harmful, abrasive and corrosive materials are processed.

**KEEPER WATER IN ...**  
Precast concrete manholes are designed to be watertight. The watertightness is achieved by using a special gasket between the manhole and the concrete structure. This gasket is made of a special material that is resistant to water and other liquids.



**... AND OUT!**  
Precast concrete manholes are designed to be watertight. The watertightness is achieved by using a special gasket between the manhole and the concrete structure. This gasket is made of a special material that is resistant to water and other liquids.



**REDUCES THE RISK OF FLOODING.**

Precast concrete manholes are designed to be watertight. The watertightness is achieved by using a special gasket between the manhole and the concrete structure. This gasket is made of a special material that is resistant to water and other liquids.

**... AND SURE THE CLEAN!**

Precast concrete manholes are designed to be watertight. The watertightness is achieved by using a special gasket between the manhole and the concrete structure. This gasket is made of a special material that is resistant to water and other liquids.

**DOES NOT LEACH HARMFUL CHEMICALS**  
Precast concrete is an extremely strong material. It is made of a special material that is resistant to water and other liquids. This makes it a perfect choice for use in systems that distribute drinking water through tunnels.



Precast concrete pipes have been subjected to extensive testing and have a long history of service in many underground applications.

See also:

[www.lafargeprecast.ca/resources/projects/1/custom/precast/index.html](http://www.lafargeprecast.ca/resources/projects/1/custom/precast/index.html)

[www.precast.org/pipecomparison](http://www.precast.org/pipecomparison)

## CREDITS

*The Little Green Book of Concrete* was published in conjunction with the British Precast Concrete Federation, which developed the concept and contributed text and photos. Sue McCraven, NPCA senior technical consultant, contributed additional research, writing and technical editing. NPCA's Marketing and Communication Division provided additional writing, editing and design concepts.

Photographs on pages 25, 85, 95 and 110 are from dreamstime.com.



## **LOOKING TO THE FUTURE**

This Little Book shows that sustainability is part of everyday business for the precast concrete industry and NPCA, but we think there are still more green opportunities to come. We welcome input on new possibilities for precast – please send in your sustainability ideas and success stories to: [info@precast.org](mailto:info@precast.org)

Printed on New Leaf Reincarnation Matte, made with 100% recycled fiber and 50% post-consumer waste, processed chlorine free, designated Ancient Forest Friendly™, and manufactured with electricity that is offset with Green-e® certified renewable energy certificates. [www.newleafpaper.com](http://www.newleafpaper.com)

The association of the manufactured  
concrete products industry

10333 N. Meridian St., Suite 272

Indianapolis, IN 46290

317.571.9500 | 800.366.7731 | [www.precast.org](http://www.precast.org)



**NPCCA**

Precast ... The Concrete Solution